Book Reviews

Works intended for notice in this column should be sent direct to the Book-Review Editor (J. H. Robertson, School of Chemistry, University of Leeds, Leeds LS2 9JT, England). As far as practicable books will be reviewed in a country different from that of publication.

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Structure and bonding in solid state chemistry. By M. F. C. LADD. Pp. 326, Figs. 151. Chichester: Ellis Horwood Ltd, 1979. Price £16·50.

This is an interesting and well written textbook. It discusses the properties of solids at a level comparable to that of a good physical chemistry text, but in considerably more detail. The organization is based upon the principal types of solids, with an introductory *Preamble* followed by chapters entitled *Ionic Compounds*, *Covalent Compounds*, *Van der Waal's Compounds*, and *Metallic Compounds*, and a brief closing chapter. Each of the principal chapters discusses the nature of the cohesive forces of a particular type and uses this discussion as a basis for consideration of the structures and properties of solids in which that type of force is dominant. This works well, with the possible exception of Chapter 3 (*Covalent Compounds*) which consists of 65 pages of elementary quantum mechanics (from black-body radiation through conjugated molecules) and one page of applications to solids. Although the material is handled well and the inclusion of basic quantum mechanics is entirely in keeping with the logical structure of the book, it seems unlikely that a book whose focus is on the solid state will be a major source for many students who are learning quantum mechanics. My preference would have been to sacrifice much of this material and to devote more space to topics such as hydrogen bonding (which receives only passing mention), lower-dimensional solids, and solid-state transformations. The most serious error I noted was the statement on p. 89 that '···compounds such as NeF_4, ArF_4, and $KrCl_4$ have been prepared and studied'.

Nonetheless, this is a very attractive book. The writing style is concise but clear throughout. The material should be accessible to the student who has some knowledge of thermodynamics and elementary physics. An unusual feature is the inclusion of appendices at the end of each chapter. These appendices, 23 in number, present such diverse material as directions for construction of a stereoscopic viewer, discussion of partial molar quantities, and an introduction to quantum statistics. They accomplish well the author's goal of removing from the main text material which 'might distract readers from the development of the subject'. Another very attractive feature is the presence of a large number (about 40 by rough count) of stereoscopic crystal structure diagrams. These are well prepared and contribute significantly to the effectiveness of the book. A number of problems follow each chapter, with complete solutions provided at the end of the book. Introductory material on problem-solving techniques, physical constants, and unit conversion factors, together with a very complete glossary of symbols, is included. All things considered, this is a well conceived and carefully prepared book. It will probably find more use as supplementary reading than as the principal text for a single course.

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Modern X-ray analysis on single crystals. By PETER LUGER. Pp. xiii + 312. Berlin, New York: Walter de Gruyter, 1980. Price DM 96.00.

For anyone starting on X-ray crystal structure determination, this book is a 'must'. It takes the reader through all the stages in the process, from selection of the crystal and the X-radiation to the final calculation of the molecular geometry and the representation of the structure in diagrammatical form. The essential theory is given at every stage but it never overwhelms the practical bias of the book. This excellent balance is largely achieved by the fact that three typical structure determinations – those of potassium hydrogen tartrate (KAMTRA), ammonium tetrasulphurpentanitride oxide (NITROS), and sucrose (SUCROS) – are followed in detail through all the various stages described in the book. KAMTRA belongs to the space group $P2_12_12_1$ and the solution of its structure by the Patterson heavy-atom method is described. NITROS belongs to the centrosymmetric space group $C2/m$ and SUCROS to the non-centrosymmetric $P2_1$ and their structure solutions by direct methods are explained, including the use of the *MULTAN* suite of computer programs. At every point, the techniques described are up-to-date and commonly used, so the reader is taught good standard crystallographic practice. With a few exceptions, the explanations of theory and descriptions of practical techniques are clear and they read very easily in spite of not being written in the author's native language. (He is Professor of Crystallography at the Freie Universität Berlin.) The author acknowledges the help of Professor G. A. Jeffrey in the linguistic revision of the English manuscript, and Professor Jeffrey should be congratulated on the general high standard of the text. A few infelicities in the English have escaped his attention but the meaning is always obvious. There are also a few typographical errors.

The first chapter of the book explains all the mathematics needed for crystallographic theory, particularly matrices and determinants and basis transformations, and then goes on to discuss Fourier series and transformations and diffraction theory in relation to the reciprocal lattice. Readers who, like the reviewer, are not mathematically inclined should not be

put off by this rather difficult chapter and should skip when the going gets too hard. Mastery of the mathematics is only necessary for those who wish to understand the proof of every relationship. It is not necessary for the understanding of the rest of the book and for the application of crystallographic relationships in practice.

Chapter 2 explains the film methods of recording X-ray diffraction patterns and the interpretation of these patterns. It then goes on to discuss the generation and absorption of X-rays, with practical application in the selection of the most appropriate target material and filter, and of the voltage and current settings. Chapter 3 is concerned with all the various types of symmetry that may be associated with a crystal structure and with an X-ray diffraction pattern, the practical application here being, of course, the determination of space groups. It also includes a discussion of the Fourier-series representations of electron densities in crystals and of structure factors. Chapter 4 explains the operation of a four-circle diffractometer and includes discussions of the statistics of intensity counts and of the choice of crystal and scanning mode.

Chapter 5 is an excellent one on methods of solving the phase problem. It gives detailed and practical acounts of the Patterson and direct methods and even goes through, in detail, the beginning of a sign-determining process for a centrosymmetric crystal. Chapter 6 gives the theory of least-squares refinement of structural parameters and then outlines various practical considerations in applying the method. Finally, it discusses molecular-geometry calculations and the pictorial representation of crystal structures.

It is remarkable how much theory, practical application, and detailed example have been incorporated in the 312 pages of this excellent book. The price is rather high for anyone buying this as their first crystallographic book but it is not unreasonably high, since it will serve all the crystallographic needs of many of its readers. The printing and binding are also of a high quality. In fact, the only aspect of the book that can be seriously criticized is the title – X-ray analysis, these days, suggests the techniques of X-ray fluorescence spectroscopy and X-ray photoelectron spectroscopy, which this book is definitely not about. The book can be strongly recommended as a sound practical guide for the novice in crystal structure determination and as a handy compendium of theory and practical hints for those already familiar with the techniques.

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Gems made by Man. By K. NASSAU. Pp. xviii + 364. Radnor, PA 19089: Chilton Book Co., 1980. Price US $28.50.

This book will surely become the definitive work on this subject that the foreword (by the President of the American Gemological Institute) anticipates. The author, who is known also for his earlier pioneering of laser technology, has been active in solid-state science, crystal growth and gem technology for the past 25 years and is a widely respected authority in the science of gemology (gemmology in the UK).

The overall emphasis is on the production and characterization of gem materials. After two chapters on preliminaries, four large sections, each of three or four chapters, deal with the four largest families of gems: ruby, quartz, emerald and diamond; further sections then take in almost the whole range of other gem materials, including garnet, spinel, rutile, opal and alexandrite, and many more. The book gives systematic attention to the history of the subject, relating the early attempts and successes in each of the various areas (ruby by Verneuil growth; diamond – a saga with considerable drama; garnet by Czochralski pulling...) and proceeds from these beginnings to detailed accounts of the most modern, commercial techniques. The coverage of the book is exhaustive, the attention to detail impressive; its readability is superb, and the numerous, excellent illustrations make the book quite hard to put down; cross-referencing is frequent and most useful, and the index is meticulous. There are also practical suggestions for further reading. The book is characterized by a happy combination of scientific and technical detail with artistic appreciation and with the intimacy of craftsman's knowledge. It is only a pity that the current technological capabilities of laboratories outside the USA and France – notably in the Soviet Union – could not be included in the illustrations.

For the crystallographer, there is not much here specifically on the crystallographic aspects of these materials, although the two chapters on crystal growth and the origin of colour in crystals are both sound and well written. But, for sheer enjoyment of a masterly presentation of a field in which crystals are the centre of attention, this book is very highly recommended.

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X-ray analysis and the structure of organic molecules. By JACK D. DUNITZ. Pp. 514. Ithaca: Cornell Univ. Press, 1979. Price US $55.00, £33·00.

Professor Dunitz's book is one of the well known series based on the George Fisher Baker non-resident lectureships in chemistry at Cornell University. Attendance at the lectures must have been a stimulating experience, and inevitably something of the excitement is lost in the expansion to book form. To use the author's own analogy, it is difficult to provide a comprehensive guidebook (on crystal analysis methods for chemists) which readers will want to read from cover to cover. Some of the lecturer's anecdotes do not transform well to the printed page. The conversation on pages 213–215, for example, would be very effective in a lecture, but it seems unnecessarily wordy (the author thinks perhaps frivolous) in book form.